



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/537,158	05/31/2005	Fabio Biscarini	40379/DOB/lp	1458

7590 12/05/2006
Modiano & Associati
Via Meravigli 16
Milano, 20123
ITALY

EXAMINER

WHITEHEAD, ELIZABETH A

ART UNIT PAPER NUMBER

1762

DATE MAILED: 12/05/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/537,158

Applicant(s)

BISCARINI ET AL.

Examiner

Elizabeth Whitehead

Art Unit

1762

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 24 August 2005.
2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 18-34 is/are pending in the application.
4a) Of the above claim(s) _____ is/are withdrawn from consideration.
5) ☐ Claim(s) _____ is/are allowed.
6) ☒ Claim(s) 18-34 is/are rejected.
7) ☐ Claim(s) _____ is/are objected to.
8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
10) ☒ The drawing(s) filed on _____ is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date 5/31/2005.
4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Specification

1. The following guidelines illustrate the preferred layout for the specification of a utility application. These guidelines are suggested for the applicant's use.

Arrangement of the Specification

2. As provided in 37 CFR 1.77(b), the specification of a utility application should include the following sections in order. Each of the lettered items should appear in upper case, without underlining or bold type, as a section heading. If no text follows the section heading, the phrase "Not Applicable" should follow the section heading:

- (a) TITLE OF THE INVENTION.
- (b) CROSS-REFERENCE TO RELATED APPLICATIONS.
- (c) STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT.
- (d) THE NAMES OF THE PARTIES TO A JOINT RESEARCH AGREEMENT.
- (e) INCORPORATION-BY-REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC.
- (f) BACKGROUND OF THE INVENTION.
 - (1) Field of the Invention.
 - (2) Description of Related Art including information disclosed under 37 CFR 1.97 and 1.98.
- (g) BRIEF SUMMARY OF THE INVENTION.
- (h) BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S).
- (i) DETAILED DESCRIPTION OF THE INVENTION.
- (j) CLAIM OR CLAIMS (commencing on a separate sheet).
- (k) ABSTRACT OF THE DISCLOSURE (commencing on a separate sheet).
- (l) SEQUENCE LISTING (See MPEP § 2424 and 37 CFR 1.821-1.825. A "Sequence Listing" is required on paper if the application discloses a nucleotide or amino acid sequence as defined in 37 CFR 1.821(a) and if the required "Sequence Listing" is not submitted as an electronic document on compact disc).

3. The Specification does not include a Brief Description of the Drawings submitted. Appropriate correction is required.

4. Applicant should note that failure to include a Brief Description of the Drawings could result in a delay of the application process.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

6. Claims 18-34 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for applying AFM or stamping as a perturbation on regions of a thin film of rotaxanes or catenanes to form nanostructures by the self-organisation of said thin film molecules, does not reasonably provide enablement for applying any type of external perturbation on regions of any bistable or multistable thin films and achieving a collective morphological transformation and self-organization of molecules as broadly encompassed by the claims. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make the invention commensurate in scope with these claims.

7. Despite statements in the specification concerning all of the methods of perturbation (thermal, thermomechanical, electrical, magnetic, light) that can be applied on any bistable or multistable thin films, there is little enabling disclosure of applying a perturbation other than AFM or stamping on a thin film of molecules other than rotaxanes or catenanes. This disclosure represents inadequate support for all perturbation methods and all bistable or multistable molecules.

8. The subject matter to which the claimed invention pertains is a complex process combining two paradigms of bottom-up approaches to spontaneously form arrays of nanostructures on a substrate with spatially organized structure for information storage. The bottom-up patterning technique comprises depositing a thin film of multistable molecules, which will undergo a morphological transformation when an external

perturbation is applied. The transformation then causes the self-organization of the multistable molecules to form nanostructures. The multistable molecules must be chosen by matching several conditions of thin film/substrate surface energy and surface diffusivity of the adsorbate the thin film is made of.

9. The prior art for information storage on molecular memory systems deposits thin films consisting of rotaxanes or catenanes onto a substrate wherein a mechanical perturbation such as AFM or a stamp is used to apply the necessary energy to cause the morphological transformation of the thin film molecules. "Information Storage Using Supramolecular Surface Patterns" by Cavallini et al discloses a method for forming nanostructures by depositing a thin film of rotaxanes on a substrate and applying an atomic force microscope or a stamp to said film to cause the transformation (Col. 1, Par. 3 and Col. 3, Par. 2). "Conformational Self-Recognition as the Origin of Dewetting in Bistable Molecular Surfaces" by Cavallini et al discloses forming a thin film of catenanes on a mica substrate and causing the molecules to undergo a wetting/dewetting morphological transformation by external stimuli (Pg. 10826, Par. 2 and 3). Chen et al (2002/0172072) discloses electrically perturbing a layer of rotaxanes wherein the molecules are "switched" to store information ([0011]). However, the electrical perturbation of the film of rotaxanes does not result in a morphological transition to form nanostructures.

10. The invention discloses that the reorganization process has been observed and controlled in the rotaxanes and catenanes, but a variety of other molecules prepared in the form of a thin film have *not* exhibited any reorganization phenomena based on

Art Unit: 1762

external stimuli (Pg 14, lines 4-8). One skilled in the art could not readily anticipate the effect of using molecules other than rotaxanes or catenanes in the form of a thin film, which leads to a lack of predictability in the art. Also, Chen et al (2002/0172072) uses an electrical perturbation to cause the self-organization of a rotaxane film, but the self-organization does not result in the formation of nanostructures. Therefore, one skilled in the art could not readily anticipate the effects of using a non-mechanical perturbation to cause the self-organization of the thin film molecules, which leads to a lack of predictability in the art.

11. The inventor provides direction to form a thin film of rotaxanes or catenanes on a substrate wherein the film is perturbed by AFM or a stamp. Little is known in the prior art about the nature of the invention and the art is unpredictable, therefore more detail would need to be provided for one skilled in the art to make the invention using other molecules such as DNA or other methods of perturbation such as electrical perturbation without undue experimentation.

12. The working example in the specification deposits rotaxane 1 onto graphite and perturbs the film with a stamp wherein the applied pressure is 2.5 kg/cm^2 . It is not expected that this example could be extrapolated across the entire scope of the claims because in the specification it is mentioned that a variety of molecules used to form a thin film did not exhibit the desired reorganization phenomena when perturbed by external stimuli. Also, the working example could be extrapolated to any mechanical perturbation since it is known in the prior art that rotaxanes deposited onto graphite or mica can be perturbed using AFM and achieve similar results, but it is not expected that

Art Unit: 1762

the example could be extrapolated to encompass all means of perturbation because in the prior art electrical perturbation applied to a thin film of rotaxanes did not result in the formation of nanostructures.

13. Due to the aforementioned factors, there would be an extraordinary amount of experimentation required to determine which combination of perturbation and molecules could be used to form the desired nanostructures. The examples only specify using AFM or a stamp for the perturbation wherein the thin film comprises rotaxanes or catenanes. Applicant is claiming that any method of perturbation can be applied to any bistable or multistable molecules. There are an exponential amount of possible combinations of perturbation methods and thin film molecules and determining which combinations achieve the desired nanostructures would require an extraordinary amount of undue experimentation.

14. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

15. Claims 29, 30, 32, and 33 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

16. A broad range or limitation together with a narrow range or limitation that falls within the broad range or limitation (in the same claim) is considered indefinite, since the resulting claim does not clearly set forth the metes and bounds of the patent protection desired. See MPEP § 2173.05(c). Note the explanation given by the Board

of Patent Appeals and Interferences in *Ex parte Wu*, 10 USPQ2d 2031, 2033 (Bd. Pat. App. & Inter. 1989), as to where broad language is followed by "such as" and then narrow language. The Board stated that this can render a claim indefinite by raising a question or doubt as to whether the feature introduced by such language is (a) merely exemplary of the remainder of the claim, and therefore not required, or (b) a required feature of the claims. Note also, for example, the decisions of *Ex parte Steigewald*, 131 USPQ 74 (Bd. App. 1961); *Ex parte Hall*, 83 USPQ 38 (Bd. App. 1948); and *Ex parte Hasche*, 86 USPQ 481 (Bd. App. 1949).

17. In the present instance, claim 29 recites the broad recitation wherein said morphological transformation is obtained by dewetting introducing spatial correlation, and the claim also recites "particularly" spinodal dewetting which is the narrower statement of the range/limitation.

18. Claim 30 recites the broad recitation wherein said molecules are selected from the group consisting of rotaxanes, and the claim also recites "particularly" rotaxane 3 and rotaxanes terminated with optically/electrically active groups and conjugated stoppers which is the narrower statement of the range/limitation.

19. Claim 32 recites the broad recitation wherein said molecules are selected from molecules having an isomerizable double bond, and the claim also recites "particularly" molecules containing a linear C=C bond with cis-trans isomerization which is the narrower statement of the range/limitation.

20. Claim 33 recites the broad recitation wherein said molecules are selected from biological motors, and the claim also recites “particularly” actine, miosine, oligopeptides, DNA, RNA, and oligonucleotides which is the narrower statement of the range/limitation.

21. Also Claim 33 recites that said molecules are selected from molecular motors and actuators and biological motors. The claim is rendered indefinite because it is unclear whether the molecules are selected from either molecular motors, actuators, or biological motors, or the molecules belong to all three specified groups.

Claim Rejections - 35 USC § 102

22. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

23. Claims 18, 22, 24, 25, 29, 30, and 34 rejected under 35 U.S.C. 102(a) as being anticipated by “Information Storage Using Supramolecular Surface Patterns” by Cavallini et al., herein referred to as Cavallini et al. (2003).

24. Cavallini et al. (2003) discloses a process for forming nanostructures by growing a thin film of rotaxanes by drop casting onto a substrate (Col. 1, Para. 3). A mechanical perturbation with preset magnitude is applied to a localized region using an atomic force microscope tip (Col. 1, Para. 4), which provides the necessary energy for the rotaxane film to recrystallize (Col. 2, Para. 3). Scanning a series of lines results in a regular array of dots with preset number, size, interspacing, and shape (Col. 2, Para. 1).

Art Unit: 1762

25. Thus, Cavallini et al. (2003) describes or reasonably suggests every limitation of claims 18, 22, 24, 25, 29, 30, and 34 and thus, anticipates these claims.

Claim Rejections - 35 USC § 103

26. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

27. Claim 31 is rejected under 35 U.S.C. 103(a) as being unpatentable over Cavallini et al. (2003) in view of "Conformational Self-Recognition as the Origin of Dewetting in Bistable Molecular Surfaces" by Cavallini et al, herein referred to as Cavallini et al (2001).

28. Cavallini et al. (2003) is relied upon as discussed in the 35 USC 102^a(~~e~~) rejection above. Cavallini et al. (2003) does not disclose using catenanes to form the thin film of bistable molecules.

THM
12/21/04

29. Cavallini et al. (2001) discloses a thin film formed by a catenane can provide an example of bistable behavior, which can be triggered by external stimuli (Col. 1, Par. 1) to manifest itself in a wetting/dewetting morphological transition (Col. 1, Par. 2) which can generate patterns with a characteristic length scale (Col. 2, Par. 2).

30. It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to use the method of Cavallini et al (2003) to form nanostructures wherein the rotaxane is substituted with a catenane as suggested by Cavallini et al. (2001) because catenanes also have a mechanically interlocked structure which is

intrinsically related to the transformation taking place and they can be synthesized with a variety of functional groups.

31. Thus, claim 31 would have been obvious within the meaning of 35 USC 103 over the combined teachings of Cavallini et al (2003) and Cavallini et al (2001).

32. Claims 19-21, 23, and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Cavallini et al (2003) in view of Mirkin et al ('979).

33. Cavallini et al (2003) is relied upon as discussed in the 35 USC 102^a(g) rejection above. Cavallini et al (2003) also discloses that the dots are formed with the density, spacing, and size controlled by the thickness of the film. The number of dots is controlled by the length of the line scan (Col. 2, Par. 1) and the dots can code and store information with areal densities of 10-100 Gbps (Col. 3, Par. 1). Cavallini et al (2003) does not disclose that the nanostructures are in the form of strips or that the perturbation is applied with a mechanical device able to produce multiple perturbations.

*Turn
12/2/06*

34. Mirkin et al ('979) discloses a method of forming nanostructures using an AFM tip to deliver ink to the substrate wherein the nanostructure formed comprises a line or multiple lines (Claim 66, 80, and 81). Mirkin et al ('979) also discloses that a multiple array tip may be used to pattern large areas wherein the "writing tips" reproduce the structure generated by the "imaging tip" which is used to lithographically pattern the substrate (Col. 39, lines 40-64).

35. It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to use the method of Cavallini et al (2003) to form nanostructures comprising lines as suggested by Mirkin et al ('979) wherein multiple tips could be used

with the AFM also suggested by Mirkin et al ('979) because the multiple tips are advantageous to patterning large areas.

36. Thus, claims 19-21, 23, and 26 would have been obvious within the meaning of 35 USC 103 over the combined teachings of Cavallini et al (2003) and Mirkin et al ('979).

37. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Cavallini et al (2003) in view of "Printing meets lithography: Soft approaches to high-resolution patterning" by Michel et al, herein referred to as Michel et al (2001).

38. Cavallini et al (2003) is relied upon as discussed in the 35 USC 102^a(~~e~~) rejection above. Cavallini et al (2003) does not disclose applying a perturbation using a stamp with a load force of 0.1-100 kg/cm² (approx. 9.8-9806.7 kPa).

Then
12/21/06

39. Michel et al (2001) discloses a lithography method using a thin film stamp with a load force of 40 kPa (p. 706, Col. 2, Par. 2).

40. It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to use the method of Cavallini et al (2003) to form nanostructures using a stamp as suggested by Michel et al (2001) to apply the perturbation because a stamp can apply multiple sources of perturbation to pattern large areas and the load force of 40 kPa anticipates a value in the claimed range of 9.8-9806.7 kPa.

41. Thus, claim 28 would have been obvious within the meaning of 35 USC 103 over the combined teachings of Cavallini et al (2003) and Michel et al (2001).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Elizabeth Whitehead whose telephone number is (571) 272-6647. The examiner can normally be reached on Monday-Thursday, 7:00 AM-5:30 PM, EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks can be reached on (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

eaw



TIMOTHY MEEKS
SUPERVISORY PATENT EXAMINER